Active safety device for table-mounted circular saws

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Inventor:	HAUER SEBASTIAN (DE); NIEBERLE JAN (DE)
Applicant:	HAUER SEBASTIAN (DE); NIEBERLE JAN (DE)
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Abstract of **DE19609771**

A device to improve the working safety and operational comfort of circular saw benches has electronic hand recognition placed in front of the saw blade which triggers protective measures if necessary. The saw blade can be lowered hydraulically or pneumatically, triggered thus by the electronics. The protective hood which covers the saw blade terminates with the work table and the workpiece without a gap by means of a sliding or lifting device and is matched mechanically or automatically to the height of the work piece. The hood is transparent so that the view of the workpiece is not obscured.

TRANSLATION

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Applicants: Nieberle, Jan, 22607 Hamburg, DE; Hauer Sebastian, 22145 Hamburg, DE

Inventor: Same as applicants.

The following information has been taken from documents submitted by the applicants.

The content of this paper deviates from the documents submitted on the registration day.

(54) Active Safety System for a Circular Saw Bench

(57) Circular saw benches are among the most dangerous machine tools used in professional as well as hobby work applications. It is primarily the characteristic structure of the circular saw bench that makes it a dangerous tool for the user. Current safety mechanisms do not provide reliable protection against injury and often obstruct work to such an extent that they are dismantled and thus, provide no protection at all. The protective hoods, for example, are usually unstable, cover the saw blade inadequately, and obstruct visibility of the workpiece because they are not transparent. Our work consists of a safety concept, which should effectively protect the user from injury and not impair work comfort, but rather, should raise it. The protective hood covers the saw blade completely when at rest and is controlled by electronics and is automatically brought to the required work height as soon as a piece of wood approaches. It therefore always provides the maximum possible protection. In addition, the protective hood is transparent and allows observation of the workpiece during the sawing process. A laser, which is mounted in the protective hood, projects a red line that optically extends the cutting line and thus permits simple alignment of workpieces. Moreover, it has a warning function: If the red line falls on a hand lying in the cutting line on the wood, one is (warned) about the forthcoming .... (page cut off here)

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Description

The invention concerns a device per the generic concept outlined in Claim 1.
So that fingers and hands are protected from cutting injuries, a hand detection sensor in combination with a saw blade swing-out device have been installed.
Circular saw benches are known, which have been built per DIN 38821. These machines are designed to saw wood and other materials. They are characterized by a very high risk of injury during operation.
The task of this invention is to make work with circular table saws safer and more comfortable. This task is achieved by a device with the characteristics of Claim 1. The advantages of the invention are the electronics, which can recognize whether the saw blade can move below the work surface by means of pneumatics or hydraulics, so that there is no more danger for body members. Moreover, there is saw blade protection terminating with the saw bench and workpiece without a gap, which fulfills the purpose of preventing grabbing the saw blade from the side or above. In addition, a laser projects the cutting line of the saw blade onto the bench so that one can recognize whether the workpiece is correctly positioned. In addition, the user's attention is optically brought to the danger zone.

Designating the Cutting Line

In the protective hood of our circular saws we have installed a "laser liner", which projects a red line and makes the cutting line optically visible. This fulfills two purposes: on the one hand, you can comfortably align workpieces with the indicated cutting edges by hand if an angle stop is not absolutely necessary. In addition, it is possible to align very large work pieces, which are too wide for the angle stop. On the other hand, The red line has a warning function: if you guide the workpiece by hand on the cutting line, the red line falls on the hand. This should draw attention to the danger coming ahead in a few centimeters..

The laser consists of a laser diode, whose dot-like beam is expanded into a line via a glass bar. This laser diode has a power of 3 mW and falls into laser protection class IIIa. This performance level is not quite enough to easily recognize the line in daylight. Because you cannot look directly into the beam and the power is distributed over the line, you can also use a laser with 10 mW, for example. The protective hood in which the laser is mounted, is stable and low-vibration so that the red line does not deviate from the cutting line.

The Protective Hood

Our goal was to develop a protective hood, which covers the saw blade as well as possible in order to prevent injury to the user. The protective hood should not cover the view of the saw blade, hence to a view of the point where the saw blade meets the

workpiece is a prerequisite for a precise cut. The protective hood should be designed so that it does not impede the user in his work, because then there is the danger that it will be dismantled. The protective hood must be held as if it wasn't even there and must convey the impression that it makes sense and serves the work process. Because the height adjustment of the protective hood disturbs work, this process in particular must be simplified. We have defined two variations for the opening of the protective hood:

a) The Manual Variation

This is an opening mechanism, which is actuated by the user guiding the workpiece. By pushing the workpiece in the direction of the saw blade, it presses against the front edge of the protective hood. Due to the design of the suspension of the protective hood, as seen in the diagram, the protective hood moves backward and upward. As soon as the protective hood reaches the height of the workpiece, it remains standing in this height and you can slide the workpiece below and past. This variation assures that the protective hood covers the saw blade as much as possible and thus, offers maximum protection. This solution is also extremely insensitive to disturbances. However, the protective hood rests on the workpiece when it slides through. We built this variation and worked a while with it. We then decided in favor of the second variation, because the manual version would certainly be too uncomfortable or irritating for some users.

b) The Automatic Variation

This is a similar solution to the first variation. The difference is that the protective hood does not open by pressing the workpiece but rather is moved upward via a lifting gear with control electronics. An IR-sender/reception pair is located at the top of the protective hood. If the workpiece comes in the range of the IR-beam, this is reflected by the front edge of the workpiece and hits the IR receiver. The electronics then allow the lift gear to move the protective hood up. If the height of the workpiece is reached, the IR sender beams past over the front edge of the workpiece and the reflected signal remains off. In this moment, the lift gear is stopped and you can push through the workpiece. These electronics work with the hand detection sensor, as a result, the protective hood does not move upward if instead of the workpiece a hand is held before the protective hood. This variation is more elegant than the first and will hardly disturb anyone in his or her work. The electronics are simple and not susceptible to interference.
For both variations, the protective hood consists of Plexiglas "Makrolon", which is extremely resistant and cannot be scratched. Because the specified dust vacuum on the protective hood has nothing to do with our objective "safety", we did not consider it in order to reduce expense.

The Hand Detection Sensor

Hands and fingers are especially endangered when working with circular saws. One of our goals was to find a sensor which can recognize whether a finger or hand is guiding (the workpiece) into the saw blade. However, there is no commercially available sensor, which fulfills this requirement. Motion sensors, for example, can record the motion, but

do not distinguish between wood or a hand. [illegible] of sensors, which in theory could recognize a hand based on its radiated heat, can be imitated by cold hands or hot wood. For this reason, we have developed a sensor, which is based on an idea of the Russian Leon Theremin from 1920. The so-called "Theremin oscillator" was the first synthesizer to create sound. The circuitry consists of two oscillators, of which one vibrates at a fixed frequency, the other changes its frequency depending on a hand approaching a copper plate, which together with the hand forms a parallel capacity to the capacity in the vibration circuit. The difference of both frequencies is proportionate to the hand approaching the copper plate, which is located below the work bench before the saw blade. Due to the low electrical polarization capacity of wood compared to a hand, the wood has a smaller effect on the sensor than the hand. This makes it is possible to distinguish a hand from wood. After a certain value of frequency difference, i.e., when the hand reaches a certain proximity to the sensor plate and thus, the saw blade, the sensor electronics trigger the emergency off lowering device.

The workbench posed a problem because it is made of metal and also acts as sensor if the distance to the sensor surface is too small. In order to eliminate this problem we have enlarged the plastic insert around the saw blade. The oscillator electronics are mounted directly below the sensor surface in order to prevent a disturbance through electro-magnetic alternating fields in the environment.

The Emergency-Off Lowering Device

The saw blade is the main source of danger on a circular table saw. In order to offer effective protection from injury, one must make the saw blade harmless in some way. Braking the saw blade is possible, but this could happen abruptly. The time needed from recognizing the hand in front of the saw blade to braking the saw blade up to the time it finally comes to rest would still be enough to move the hand into the (still) rotating saw blade.

We have designed an emergency off function, which does not brake the saw blade but rather, removes it out of the range of the hand: if a hand is recognized before the saw blade, the sensor electronics control a valve, whereby a pneumatic cylinder abruptly pulls the motor with the saw blade downward. The saw blade vanishes completely below the work table. This method has the advantage that it is very fast and works completely wear-free. After triggering the lowering, the saw blade can be moved upward again through the cylinder by pressing a button. Pneumatic air with a pressure of 10 bar is required for the cylinder. A small compressor with a pressure reservoir, like one can buy at any construction store, is suitable. If the saw is used in businesses, this procurement is not necessary because it is usually already available.
To guide the moving motor apparatus, the present guide to adjust the cutting height is used. The cutting height adjustment function is now done via a hand crank, which can adjust the cylinder and thus the saw blade height via a spindle and scissors mimic.

Conclusion

In contrast to traditional circular bench saws, based on the newly applied safety technology of the invention it is now possible to work comfortably and above all, safely. In particular, various safety devices that fulfill the U.S. Norm 38821 effectively reduce the risk of injury for these machines. The hand detection sensor, in connection with the emergency off/protection switch, makes it virtually impossible to injure oneself on the machine. The laser cutting line designation warns the user of the saw blade and at the same time, simplifies precise workpiece processing.

The invention sets new standards regarding work safety and operating comfort and thus, improves the work place for the professional and hobby worker alike.

Patent Claims

1. Device to improve the work safety and the operating comfort of circular table saws, characterized by electronic hand recognition being placed before the saw blade, which triggers protective measures in an emergency situation.
2. Device per Claim 1, characterized by the saw blade being lowered hydraulically or pneumatically, triggered by electronics.
3. Device per Claim 1, characterized by the protective hood, which covers the saw blade, terminating with the workbench and workpiece by means of a slide or lift device without a gap and the height of the workpiece is adjusted mechanically or automatically.
4. Device per Claim 1 characterized by a transparent protective hood, which covers the saw blade, and thus, the view of the workpiece is not obstructed.
5. Device per Claim 1, characterized by the cutting line visualized before the saw blade with a laser, which projects the line onto the workbench.

4 pages of drawings follow.